



DIGITAL AUDIO SYSTEM FOR RADIO STATIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates generally to a digital audio system for radio stations, and more particularly pertains to a programmable digital audio system for radio stations wherein the music to be played and broadcast over the radio station is stored in a  
10 digital database from which it is recalled pursuant to prior programming of the operation of the radio station.

2. Discussion of the Prior Art

Recording of audio music has progressed significantly over the past decade. The introduction of  
15 digital audio music has created a revolution in the quality of sound available for home users and for radio stations nationwide. The compact disk has become the standard for high quality digital audio, and has had a high acceptance rate in the marketplace.

20 In a typical prior art radio station environment, the disks to be played and broadcast are located and retrieved from a CD musical library. The disks are then loaded into a CD player, the music cued to play, and subsequently the disks are returned to the  
25 library after play, actions which require time, labor, money and space. With the latest developments in computer technology, many of these steps can be eliminated to result in bottom-line savings to a commercial radio station.

30 SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide a digital audio system for

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1 radio stations wherein the broadcast music is stored in  
a digital database to provide a programmable radio  
station.

The concept of the present invention is  
5 relatively straightforward; instead of having the music  
exist on compact disks, the music is stored in a common  
digital database which is present in a computer system.  
The operator only needs to point an arrow at the name of  
the desired song to be played, press a button and the  
10 music is then immediately played in full digital sound.  
The order of the songs can be programmed in advance and  
played without staff intervention. Commercials and  
station promotions can be inserted as needed.

The database is created by loading desired CD  
15 tracks from the station CD library once, and additional  
songs can be loaded as necessary. Once the database is  
created, the compact disks need not be used again; all  
music is played directly from the database.

Another feature of the present invention  
20 improves the system operation and performance even more.  
If a song is not available in the radio station's  
database, it can be transmitted to the system upon  
request over a telecommunications link that provides  
music from a master library database to the station's  
25 system.

Each system can be customized to the station's  
operational procedures. The system can adapt current  
forms and provide any reports that the station currently  
requires, and station logs can be maintained auto-  
30 matically. All required FCC logs can be automatically  
recorded, summarized, and printed as required.

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1           The present invention provides substantial  
cost savings in the operation of a commercial radio  
station in the following areas:

          In staffing, fewer people are required for the  
5 station operation. Compact disks no longer need to be  
taken from the library and returned after each play.  
People are not needed to cue songs to play, as it is  
automatically handled by the system of the present  
invention.

10           In space savings, large music libraries are no  
longer necessary. Music is loaded once in advance into  
the system, and the source of the music (e.g., CD) need  
not be stored or saved.

          In equipment savings, fewer tape/CD players  
15 are necessary, resulting in dramatic maintenance cost  
savings.

          In efficiency, the system of the present  
invention is very easy to operate. The person in charge  
of programming selects the music to be played and places  
20 the music in a desired program order. A prior day's  
program can be used as a guide in planning future  
programming. The system then validates the selections  
and requests the loading of any material not present  
either by tapes/CD's or by downloading if available.

25 Work station consoles are available throughout the  
station for use by engineers, DJ's and others  
responsible for station operation.

          In reliability, a backup computer system  
automatically takes over for the primary computer system  
30 in case of failure. All music in the database can have  
a second standby copy available and backup-power to take

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1 over in an emergency, to operate the system in a fail-safe mode.

Listener response can also be implemented into the digital audio system for radio stations of the present invention. A listener call-in number can be tied into the system so that requested songs can be automatically played. Songs can be selected by a touch-tone phone without involving station personnel. A connection can also be made available to local interactive cable TV networks such that subscribers can have the same capabilities via the television set. Listener demographic information can be easily collected, which can be used for advertising, promotional, or programming purposes.

15 The system of the present invention revolutionizes the way that radio stations operate. Ease of use, cost savings, and increased station efficiency provide a quick return to the station. Additional features and options such as user call-in via telephone or interactive cable television provide tremendous marketing opportunities resulting in more listeners and higher advertising revenues.

In accordance with the teachings herein, the present invention provides a digital radio broadcast station which includes a common digital database having stored therein a plurality of at least several hundred different selections of music to be played and broadcast by the radio station. A processor system is provided for programming the digital radio broadcast station with a sequence of music selections, which are subsequently

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1 retrieved in order from the common digital database and  
played over the digital radio broadcast station.

5 In greater detail, the processor system  
includes a main computer system for operating the radio  
station, and also a backup computer system for operating  
the radio station in the event of a failure of the main  
computer system. In that regard, a fiber optic cable  
connects the main computer system with the backup  
10 computer system for switching between the main and  
backup computer systems. The processor system is  
preferably based upon Reduced Instruction Set Computing  
(RISC) architecture. The processor system preferably  
comprises an IBM RS/6000 system with an AIX operating  
system, and also includes first and second disk drive  
15 controllers. The common digital database comprises a  
disk array storage, preferably a dual port RAID disk  
array. The digital radio broadcast station also  
includes a plurality of work station consoles for use by  
personnel responsible for operating the radio station  
20 such as disc jockeys and engineers. A bridged network  
which may include a modem is also provided for  
connecting the radio station to a further digital  
database for music selections not stored in the common  
digital database. The processor system is provided with  
25 a connection to a telephone network, such that radio  
station callers can communicate with the radio station  
by a touch tone telephone. The processor system is also  
provided with a connection to an interactive cable  
television network, such that cable television viewers  
30 can communicate with the radio station over the  
interactive cable television network.

1           The present invention also provides a method  
for operating a radio station which includes digitally  
storing in a common digital database, of a computer  
system, a plurality of at least several hundred  
5 different selections of music which is to be played and  
broadcast by the radio station. Pursuant to the method,  
the computer system is programmed with a sequence of  
music selections to be played by the radio station, and  
the programmed sequence of music selections is  
10 subsequently retrieved from the common digital database  
and broadcast over the radio station.

          The method of operation preferably utilizes a  
main computer system for operating the radio station and  
a backup computer system for operating the radio station  
15 in the event of a failure of the main computer system,  
with the processor systems preferably being based upon  
reduced instruction set computing architecture. The  
main computer system and the backup computer system are  
connected by a fiber optic cable connection for  
20 switching between the main and backup computer systems.  
The method of operation of the radio station also  
provides a plurality of work station consoles for use by  
personnel responsible for operating the radio station,  
such as disc jockeys and engineers. In greater detail,  
25 the step of digitally storing includes digitally storing  
the plurality of at least several hundred different  
selections of music in a disk array, preferably a dual  
port RAID disk array. The method of operation of the  
computer system also provides a bridged network which  
30 may include a modem for connecting the radio station to  
a further digital database for music selections not

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1 stored in the common digital database. The method for  
operating the radio station also includes inserting  
commercials and station promotions into the sequence of  
music selections to be played by the radio station. The  
5 method of operation of the radio station also provides a  
connection to a telephone network, such that radio  
station callers can communicate with the radio station  
by a touch tone telephone, and further provides a  
connection to an interactive cable television network,  
10 such that cable television viewers can communicate with  
the radio station over the interactive cable television  
network. The method of operation of the radio station  
also provides a plurality of work station consoles for  
use by personnel responsible for operating the radio  
15 station such as disc jockeys and engineers. The step of  
digitally storing includes storing the plurality of at  
least several hundred different selections of music in a  
disk array, preferably a dual port RAID disk array.

Pursuant to the teachings of the present  
20 invention, the common digital database, either at the  
radio station or provided elsewhere, can also be used to  
provide an audio on demand service or system. In the  
audio on demand system, a communications network is  
provided to users, wherein a user communicates with the  
25 computer system over the communications network to  
indicate a choice of one or more music selections. The  
choice of one or more music selections is then retrieved  
from the common digital database and transmitted over  
the communications network to the user.

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1 In greater detail, the communications network  
can be provided by a telephone system, wherein a user  
communicates with the computer system by a touch tone  
telephone to indicate a choice of one or more music  
5 selections, and the one or more music selections are  
then transmitted over the telephone system to the  
caller. The communications network can also be provided  
by an interactive cable television network, wherein a  
user communicates with the computer system over the  
10 interactive cable television network to indicate a  
choice of one or more music selections, and the one or  
more music selections are then transmitted over the  
interactive cable television network to the user.

BRIEF DESCRIPTION OF THE DRAWINGS

15 The foregoing objects and advantages of the  
present invention for a digital audio system for radio  
stations may be more readily understood by one skilled  
in the art with reference being had to the following  
detailed description of several preferred embodiments  
20 thereof, taken in conjunction with the accompanying  
drawing wherein Figure 1 is a block diagram of an  
exemplary embodiment of a digital audio system for radio  
stations constructed pursuant to the teachings of the  
present invention.

25 DETAILED DESCRIPTION OF THE DRAWINGS

A digital audio system for radio stations  
pursuant to the teachings of the present invention can  
be implemented with the computer hardware illustrated in  
Figure 1, which shows one preferred embodiment of a  
30 Local Area Network (LAN) for a digital audio system for  
a radio station. The Local Area Network includes a

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1 first RS/6000 processor 10, a second redundant RS/6000  
processor 12, a plurality of work stations 14a, 14b,  
14c, a Dual Port RAID Disk Array 16, an Ethernet bridge  
and modem 18 to connect the LAN to a Wide Area Network  
5 (WAN), and connections 20a for stereo audio outputs to  
the radio station transmitter, 20b to telephone lines,  
and 20c to interactive cable television systems.

Pursuant to the teachings of the present  
invention, at least one processor 10 is required, but to  
10 provide for optimum performance, a processor system  
based on RISC (Reduced Instruction Set Computing)  
architecture using two processors 10, 12 is preferred.  
The processors 10, 12 accommodate the retrieval and  
output of music stored in memory while providing  
15 multiple users concurrent access to the system.

The processor system supports a high-  
availability processing mode so if one processor system  
10 fails, the other processor system 12 immediately  
takes over without interruption, which is accomplished  
20 via a fiber optic cable 22 linking the two processor  
systems.

The processor systems 10, 12 preferably  
provide hardware support for the output stereo audio,  
and preferably are provided with input/output  
25 connections based upon SCSI (Small Computer System  
Interface), which allows connection of multiple compact  
disk and disk storage units 24 (up to eight) as  
required.

The processor systems 10, 12 support Ethernet  
30 or Token Ring protocols to allow for the connection of  
multiple terminal devices, such as the work stations 14,

1 and also to provide access to remote databases, as by a  
bridged network which may include a modem 18, in a Wide  
Area Network (WAN).

5 The processor systems 10, 12 are preferably  
provided with multiple redundant connections 26 to the  
disk system 16 to minimize the possibility of system  
failure, and with connections 20b, 20c to telephone and  
cable networks to provide for listener opinions and  
requests.

10 Based upon commercially available equipment, a  
preferred processor which fulfills the requirements of  
the present invention is the RS/6000 system manufactured  
by IBM Corporation with the following components:

- 15 a. 2 Gigabytes of disk storage in the  
processor;
- b. a SCSI (Small Computer System Interface)  
Differential Controller (to provide for connections 26  
to the disk drives);
- c. 128 Megabytes of main memory;
- 20 d. FDDI (Fiber Data Distributed Interchange)  
which is a Fiber adapter (single ring) port for fiber  
optic connections 22 between the two processors;
- e. Audio capture/playback adapter (audio  
output from machine to 20a);
- 25 f. Digital tape drive with 5.0 gigabyte  
capacity for system backup (such as is available in Sony  
camcorders);
- g. 4 (minimum) CD-ROM drives;
- h. a communications adapter which is for a  
30 separate circuit card for connections to telephone/cable  
systems.

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1           Although not recommended, the dual RISC  
configuration can be replaced by a single processor or  
by one based upon a different architecture such as a  
personal computer. However, if this substitution is  
5 made, poor system performance or reliability may result.

          Regarding the disk storage 16, the primary  
requirement for the disk storage is that an on-line  
database of at least 30 gigabytes be available at any  
time. This amount of disk allows for the storage of  
10 approximately 1800 songs; additional storage can be  
added as required. The disks are configured so that if  
one disk unit fails, the system continues operation  
without interruption.

          Additional hardware requirements include:

- 15           a. A second disk drive controller to take  
over in the event that the first disk drive controller  
fails;
- b. Access to the disk drive unit from both  
processors;
- 20           c. Automatic duplication of all data onto a  
backup disk drive unit; and
- d. The ability to easily replace failed  
components without system downtime.

          These requirements are preferably met by a  
25 disk technology called RAID (Redundant Array of  
Inexpensive Disks). Using RAID, any storage subsystem  
component or processor can fail without affecting the  
overall operation of the system. The RAIDIAN ARRAY  
product, available commercially from IBM, when equipped  
30 with an additional array controller, fulfills these  
hardware requirements.

1           Each work station 14 preferably consists of a  
19-inch terminal display and a mouse connected via  
Ethernet or Token Ring to the main computer system. A  
minimum of three work stations 14a, 14b, 14c would  
5 generally be required to be used by the following  
individuals:

- a. Station Manager - responsible for  
selecting and sequencing music and reviewing FCC logs  
produced by the system;
- 10       b. Engineer - responsible for loading system  
database and monitoring station operation;
- c. On-Air Personality (DJ) - responsible for  
integrating the music sequence into an on-air program.

Each work station 14 display is preferably  
15 configured to the function to be performed. For  
example, the station manager's display can present  
programming options, while the engineer's display can  
present options relevant to the loading of music into  
the database. A primary feature of the system is that  
20 an individual with little computer experience can  
operate the work station easily as all input is entered  
by a graphical display.

Regarding communications equipment, the system  
preferably has a connection to optional remote databases  
25 via an Ethernet bridged network which may include a  
modem 18 and high speed data communication lines. This  
allows the system to access and download music which is  
not present in the digital database memory of the radio  
station's system.

30           Regarding computer software, particularly the  
operation system, when using the preferred RISC based

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1 processor configuration, a preferred operating system is  
AIX, commercially available from IBM Corporation, which  
provides support for the hardware and for easy system  
operation. Additional features of AIX include:

- 5           a. On-line access to system documentation;
- b. Support, control and design of the  
graphical displays used to operate the system;
- c. Support for a high-availability processing  
mode so that if one processor fails, a second processor  
10 takes over immediately;
- d. The ability to access the music stored in  
digital form and then convert it to audio which is then  
broadcast by the radio station;
- e. Communications support to allow access to  
15 remote systems and databases.

          The database manager will generally be custom  
software written for a particular radio station. The  
database manager stores the music so that it is  
available to the radio station, provides the director  
20 listings to the user, and determines in which computer  
system the requested song is located. Due to the unique  
requirements of the system, the database manager would  
generally be specifically written for this application.

          While several embodiments and variations of  
25 the present invention for a digital audio system for  
radio systems are described in detail herein, it should  
be apparent that the disclosure and teachings of the  
present invention will suggest many alternative designs  
to those skilled in the art.

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